Target Generation Facility (TGF)
AJP-7860 Simulation Group

Project Summary

Fiscal Year 2008

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Executive Summary

The Target Generation Facility (TGF) completed another successful simulation year. All simulations were provided on-time and met or exceeded customer expectations. In addition to completing these simulations many enhancements were added to the Target Generation Facility's aircraft dynamics engine, simulation pilot workstation and hardware infrastructure.

This fiscal year could be thought of as the year of En-Route Automation Modernization (ERAM) Operational Testing & Evaluation (OT&E). TGF supported the program from early access in October 2007, thru OT&E testing in the Spring. TGF is currently supporting regression test preparation and Discrepancy Report (DR) Validation. We expect to continue support into FY09.

TGF's new ground based simulation capability got a full workout supporting Human in the loop studies using this new capability. (see Section 1.8)

Looking forward to FY09, TGF is committed to continued support of ERAM Test activities. Research Development and Human Factors Laboratory (RDHFL) support includes support for new Data Communications (aka Data Link) experiments and Demonstrations scheduled for the winter and spring. We look forward to assisting in the development of the Technical Center NextGen laboratory with the expectation of Initial Operational Capability (IOC) in FY09. Full Tower Visual Simulation in the Human Factors Laboratory (HFL) and NextGen laboratories is anticipated.

Section 1 – Simulation Projects Supported

This section summarizes the simulation efforts supported by the Target Generation Facility during the fiscal year.

1.1 ERAM OTE Scenario Development

Simulation Dates: May 2006 – January 2008
January - April 2008

Program Office: ERAM

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Simulation Summary

This development effort required various scenarios to support both Salt Lake (ZLC) and Washington (ZDC) centers. A traffic sample was developed for several different sector combinations in each center. These sector combinations were named Test Configurations (TCs). TC1 and TC3 pertain to ZLC and TC4, TC5 pertain to ZDC. Within each Test Configuration several flight samples were developed of various complexities. These flight samples were drawn from old DYSIM exercises, previously developed scenarios provided by Lockheed Martin, and originally created with Subject Matter Expert guidance. TC1 contained Flight Sample (FS) FS3 and FS4, each of these flight samples had three levels of complexity – warm-up, intermediate, and heavy. These flight samples involved sectors 03, 04, 05, 07, 18, and 32 in ZLC. TC3 contained FS7 and involved sectors 19, and 20 in ZLC. TC4 contained FS10 and TC5 contains flight sample FS13. TC4 involves sectors 25, 26, 27, 28, 36, 38 in ZDC. TC5 involves sectors 11, 17, 18, 19, 53 in ZDC. In addition a weather scenario was prepared based on the warm-up complexity of TC1FS3. In order to test the Area of Interest (AOI) function of ERAM a multi-center simulation involving ZDC, ZNY, ZTL, PHL TRACON, and the ACY TRACON was developed as well.

1.3 Dynamic Density (HFL)

Simulation Dates: June 16 – 20 2008

Program Office: NASA Ames Research Center

Contacts: Sherri Magyarits
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609-485-8639

Parimal Kopardekar
650-604-2782

Simulation Summary

This is an ongoing effort to develop various complex metrics for evaluation of air traffic complexity. These metrics are still under development and in general can be subdivided into 3 sets of interrelated algorithms:

- FAA
- NASA
- Metron Aviation & MITRE

All of these algorithms were integrated into TGF's DRAT (Data Reduction Analysis Tool) as Dynamic Density calculations (a total of 50 variables). This is the first step of the Dynamic Density project to provide analysts with tools for statistical evaluation of data and extrapolation.

The simulation conducted in the Human Factors Laboratory was based in ZOB sectors 04, 48, 66. TMA metering was simulated in the flight sample. Three traffic samples were developed representing 100% of today's traffic, 150% of future traffic, and 200% of future traffic. DataCom levels of 30% and 90% were applied.

1.4 Stand Alone Virtual Tower

Simulation Dates: July 16 – 20 2007
August 13 – 17 2007

Program Office: DOT Volpe National Transportation Systems Center RTV-4A

Contacts: Jonathan Lee

William Vaughan
Manager Tower/TRACON Modeling and Simulation Team
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Simulation Summary

This simulation, conducted in the AFTIL laboratory, utilized the TGF HLA interface to ADACEL's older Tower Simulator to extract state data (position etc) for analysis. The primary purpose was to determine if displayed aircraft information can be used in place of out the window views to control airport traffic.

1.5 Display Playback of TCAS Scenarios

Simulation Dates: July 23 – 28 2007

Program Office: AJP-52 Future Surveillance Group

Contacts: Neal Suchy
AJP-52

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Simulation Summary

This simulation required a set of repeatable flight scenarios depicting typical conflict situations. It was necessary to show the aircraft as if they were responding to Traffic Alert and Collision Avoidance System (TCAS) inputs. The simulation display was conducted in the TGF Display laboratory and filmed to support TCAS Change Proposal (CP) 115.

1.6 Terminal Safety Taxi Time Information via HLA Interface

Simulation Dates: 5/15/2008

Program Office: AJP-78A0

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Simulation Summary

This simulation, conducted in the AFTIL laboratory, provided taxi time information via TGF's interface to the HLA interface from ADACEL's MAXSIM 3. This is part of our ongoing support for tower simulations. It was necessary to prepare a simulation of Cleveland International Airport to support this effort.

High Level Architecture (HLA) software was written to extract data from the MAXSIM simulator that the AFTIL uses and store it within a flat comma separated values file.

Data Reduction analysis tools were then written to go over the extracted data to calculate when an aircraft had started /stopped a taxi from/to the terminal and the runway. The calculated time was then saved in another file which indicated its start time, end time, total taxi time, and the total average taxi time for each runway.

1.7 Future Enroute Work Station III

Simulation Dates: August 2008 – February 2009

Program Office: ATO-P, ATO-W and ATO-E
AJP-611

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Simulation Summary:

The purpose of this simulation is to compare the Future En-route Workstation with the existing Display System Replacement (DSR) workstations from a human factors perspective. The Future En-route Workstation's automated tools were designed with human factors in mind as opposed to the commercial tools that lack integration and human factors design.

The simulation scenario consists of the generic airspace run with traffic levels of 2015. Thirty two scenarios were developed representing today's 100% traffic level, and the future's 133% and 166% traffic levels. The participants work the traffic on both types of workstations.

1.8 Empirical Test of the Tower Operations Digital Data System in Zero Visibility Conditions

Simulation Dates: July 28 – Oct 23 2008

Program Office: ATO-P Human Factors Research and Enginnering Group (AJP-61)

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Simulation Summary

Engineering Research Psychologists from the FAA Human Factors Team – Atlantic City, have designed two prototype electronic flight data interfaces (EFDIs) for use in Airport Traffic Control Towers (ATCTs). These EFDIs address the role of electronic flight data, System Wide Information management, and the Staffed NextGen Tower (SNT) concepts in NextGen. The Integrated EFDI combines EFD with a surface surveillance capability. The Perceptual-Spatial EFDI does not use surface surveillance capability, but provides a way for controllers to spatially organize EFD using a surface map of an airport.

Once the initial prototypes were functional, researchers conducted formal usability testing to identify any remaining problems and to ensure that actual users could operate the prototypes effectively. The initial usability test provided data that enabled researchers to refine the EFDIs and expand their scope into the current Tower Operations Digital Data System (TODDS), as described by Truitt (2008). In addition to making the most difficult features easier to use, TODDS adds the ability for ATCT controllers to issue digital taxi out clearances, perform tax conformance monitoring, indicate closed runway and taxiway segments, and access integrated weather information including advisories for wake turbulence separation.

The purpose of the current experiment is to compare TODDS to paper Flight Progress Strips (FPSs) in a zero visibility ATCT operation. We also want to collect additional usability data on TODDS and assess controller' ability to use the touch screen hardware. . The following research questions were investigated:

Does the Integrated TODDS provide any advantages over FPSs with surface surveillance in a zero visibility environment?

Does the Perceptual-Spatial TODDS provide any advantages over FPSs in a zero visibility environment when surface surveillance is unavailable?

What is the contribution of Airport Surface Detection Equipment – Model X (ASDE-X) for current FPS operations in a zero visibility environment?

Are the new TODDS enhancements effective and easy to use?

What additional features must we add to the TODDS designs to improve their capability and to better support the ATCT controllers' tasks?

Is the Integrated TODDS a potential solution for the SNT concept?

The experiment was conducted in the FAA Research, Development, and Human Factors Laboratory between August 26 and October 30, 2008. Current ATCT controllers were used in a human-in-the-loop, high-fidelity simulation to compare paper FPSs to TODDS under zero visibility conditions. The participants did not have an out-the-window view and had to control airport traffic using only remote surveillance capability and pilot position reports.

The TGF provided the ground simulator for the human-in-the-loop simulation. The airport simulated was fictitious and based on data developed by TGF for Boston's Logan International Airport.

Section 2 – Technical Summary

This section summarizes the technical achievements of the TGF during the fiscal year.

2.1 Ground Simulation Capabilities

TGF continued to develop its Ground simulation capabilities. We now have a complete Ground Simulation Capability that is in experimental use at the RDHFL.

2.2 Visual Simulation

TGF received funding for the development of Out The Window (OTW) views" for Tower simulations. Significant progress has been made in the simulation infrastructure. Target Initial Operating Capability (IOC) is FY09. A nine (9) Channel 270 degree system in the HFL and a six (6) channel 180 degree system for the NextGen Laboratory are planned.

2.3 Next Gen Laboratory

TGF was selected as the Air Traffic Simulator for the Technical Center's NextGen laboratory enhancement effort. Laboratory requirements are being determined and we are assisting in the planning process.

2.3 Network Infrastructure

TGF officially joined LABNET. TGF removed all administrative computers from the laboratory network infrastructure. We are on private networks 192.168.64-69. TGF interfaced the ADSB group to obtain East Coast Automatic Dependent Surveillance – Broadcast (ADS-B) data and ECGP RADAR data.

2.4 Computing Resources

TGF has procured but not received a partial technical refresh for our SimPilot positions and 10 Engineering workstations. Currently our "standard workstation" is running Fedora 8, has 2GB of memory, Intel dual core processors at about 2.4 Ghz. High rez dual link 30 inch displays are available to all developers. The tech refresh will enable OpenGL capabilities on our workstations and SimPilot stations.

Question: our current memory limits causing us to move to 64-bit architectures in the future? Chris has done some work on this with the visual simulation code.

Image generators (IG) and Displays (73 in DLP) hardware has been procured for the OTW system. Prototypes are up and running for demonstration purposes.

Back end infrastructure remains Sun based with 2 terabytes of NFS storage provided by the NAS1/NAS2 Network attached storage appliance. TGF updated our local backup

hardware and software. Our current software platform is the latest version of Sun Storagetech EBS version 7.4, which is the Sun branded version of EMC (formerly Legato) Networker software. We expanded our client availability capabilities to include not only Solaris sparc based computers but also Solaris x86, Solaris amd64 and RedHat Linux machines. We upgraded our backup server to a Sun X4200 M2 server and upgraded the tape drives in our Spectralogic 10,000 tape library to Sony AIT-5, doubling the capacity of our backup tapes

2.5 TGF Aircraft Dynamics

TGF improved its crossing logic using new trajectory prediction algorithms. New Area Navigation (RNAV) "fly offset" capabilities were developed to fly RNAV offsets. A new "following" capability to follow another Aircraft was developed. A new "group" flying capability was prototyped.

2.6 Aviation SimNet

TGF has become a primary test center for Aviation SimNet. TGF is almost fully AviationSimNet compliant, with only the Voice interface still remaining. TGF's Aviation SimNet capabilities include the installation of the AviationSimNet SimCenter Servers, to allow the TechCenter to host AviationSimNet simulations. The Technical Center's Aviation SimNet distributed simulation functionality was showcased during a proof of concept demonstration between TGF and MITRE CAASD, with NASA Langley at MODSIM.

Initial integration of the Symphonics HLA/DIS voice gateway and the WJHTC LCCCS was completed Spring 2008. Further investigation work to support joint simulation voice communications between all the participants is required. This includes integrating HLA/DIS voice communications over the internet between all the participants.

2.7 Java Plan View Display (JPVD)

TGF halted development of the C++ QT (3.x) based Plan View Display (PVD) and concentrated on a Java based replacement. This replacement is "almost ready". We are able to read and display ERAM adaptation data.

Section 3 – CRDAs

3.1 UFA/FAA Voice Recognition CRDA

Effective Dates: June 2007 to present

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This CRDA effort is being conducted to investigate and analyze the feasibility and usability of voice recognition for future TGF work.

The project is divided into three phases; voice integration with TGF, testing with TGF, and finally integration with the Technical Center's voice communication system. The project is ongoing and is currently in phase II.

The ATvoice voice recognition system, a Commercial-Off-The-Shelf

(COTS) product, provided by the UFA Corporation, maker of ATcoach, was integrated with TGF. An adaptation of Jacksonville Center was chosen for the test environment because it was already prepared and had been previously used in a simulation in which voice recordings of controllers and pilots were made.

The TGF has encountered several problems during the testing phase; the ATvoice system has only been configured and certified to run with obsolete hardware, developing a vocabulary for use with a simulation is a very time consuming process which requires sending UFA a list of phraseology and waiting for an update, the vocabulary must include all possible pronunciations of call signs and fix names or the system resorts to guessing the ATC clearance issued, finally, as the vocabulary increases so does processing time and the chances that a mistaken clearance will be selected. As we are using a COTS product, resolving these issues will require continued work with UFA to improve the ATvoice System.

Future work includes a baseline test using pre-recorded ATC clearances and updating the ATvoice system and re-running the tests to see if there has been improvement.

3.2 Boeing/FAA CRDA

Effective Dates: 2008 to present

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This CRDA is an ongoing collaborative effort between Boeing and the FAA, which has multiple sub parts. Only 2 of these currently pertain to TGF.

3.2.1 AIDL

Virtually all air traffic management systems require communication of aircraft trajectory information for purposes of tracking, prediction, and display and each of these systems seems to have its own format for the data that are communicated. Boeing has established

a data formatting specification, called AIDL (Aircraft Intent Description Language), that is proposed as a standard format for aircraft trajectory information.

As part of the FAA/Boeing CRDA, the TGF has implemented this standard into its simulation and trajectory prediction capabilities and demonstrated its functionality in creating viable tracks and trajectories. The TGF now has the ability to use AIDL as the format for flight plan input files to its simulations. The TGF's adaptation of AIDL has potential application in other TGF projects, as well, including interfacing with DESIREE, defining TAP (Terminal Area Paths) routes in the pending Newark study, facilitating DATACOM studies with HFL, and verifying commands with the ATvoice System.

3.2.2 UAS

The Boeing Rotorcraft division in Phila, has a UAS simulation lab which will be interfaced with TGF. The Boeing UAS simulator has 2 parts. Their ATCOM simulator is the high fidelity UAS modeler, additionally there is a HMI simulator for the ground station. On Sept 29th, we successfully displayed a portable ATCOM UAS target in the TGF display lab via DIS. This was a preliminary test to show the proof of concept. Over the next year, additional work will include linking the 2 remote laboratories together via BOEING LABNET, and exchanging targets via Aviation SimNet.

TGF Acronyms and Abbreviations

ADAR	ARTS Data Acquisition & Router
ADS-B	Automatic Dependent Surveillance-Broadcast
AFTIL	Airport Facilities Terminal Integration Laboratory
AGW	ARTS GateWay
AIDL	Aircraft Intent Description Language
AOI	Area of Interest
ARTS	Automated Radar Terminal System
ASDE-X	Airport Surface Detection Equipment – Model X
ATCT	Air Traffic Control Tower
CAS	Controller Awareness Study
CRDA	Cooperative Research Development Agreement
CTAS	Center TRACON Automation System
CHI	Computer Human Interface
COTS	Commercial-Off-The-Shelf
CPDLS	Controller Pilot Data Link Communications
DFS	Deutsche Flugsicherung (German Simulation)
DIS	Distributed Interactive Simulation
DR	Discrepancy Report
DRAT	Data Reduction Analysis Tool
DRVSM	Domestic Reduced Vertical Separation Minimum
DSR	Display System Replacement
DYSIM	Dynamic Simulation
EDC	Early Display Configuration
EFDI	Electronic Flight Data Interfaces
ERAM	En-Route Automation Modernization
ETVS	Enhanced Terminal Voice Switch
FAST	Final Approach Spacing Tool
FFP	Free Flight Phase
FPS	Flight Progress Strip

FS	Flight Sample
FS1, 2/2+	Full Service 1, 2/2+
GAO	Government Accounting Office
GOERS	GPS Outage En route Simulation
GPS	Global Positioning System
HAD	High Altitude Demonstration
HAT	High Altitude Test
HFL	Human Factors Laboratory
HLA	High Level Architecture
IG	Image Generator
IIF	Integration and Interoperability Facility
IOC	Initial Operating Capability
JPVD	Java Plan View Display
LAAEP	LA Arrival Enhancement Project
LCCCS	Laboratory Combined and Controlled Communications System
McTMA	Multi-Center Traffic Management Advisor
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association
OTW	Out The Window
PARR	Problem Analysis Resolution and Ranking
PAS	Pseudo Aircraft System
PDU	Protocol Data Units
PTR	Program Trouble Reports
PVD	Plan View Display
RDHFL	Research Development and Human Factors Laboratory
RNAV	Area Navigation
RVSM	Reduced Vertical Separation Minimum
SNT	Staffed NextGen Tower
STARS	Stand Alone Terminal ARTS Replacement System
TATCA	Terminal Air Traffic Control Automation
TC	Test Configuration

TCAS	Traffic Alert and Collision Avoidance System
TFM	Traffic Flow Management
TGF	Target Generation Facility
TMA	Traffic Management Advisor
TODDS	Tower Operations Digital Data System
TRACON	Terminal Radar Approach CONtrol
UAS	Unmanned Aircraft System
URET	User Request Evaluation Tool
WJHTC	William J. Hughes Technical Center
XPVD	X-windows Planned View Display

TGF Modeled Airports and Centers

ADW	Andrews Air Force Base
DCA	Ronald Reagan International Airport
EWR	Newark International Airport
Genera	Generic airspace generated for HFL studies
JFK	John F. Kennedy International Airport
PHL	Philadelphia International Airport
ZDC	Washington Center
ZID	Indianapolis Center
ZJX	Jacksonville Center
ZLC	Salt Lake Center
ZNY	New York Center
ZOB	Cleveland Center